

CLAIMS

1. In an audio system having a first audio signal and a second audio signal, said first and second audio signals having amplitudes, a method for processing said audio signals, comprising:
 - dividing said first audio signal into a first spectral band signal and a second spectral band signal;
 - scaling said first spectral band signal by a first scaling factor to create a first signal portion, wherein said first scaling factor is proportional to said amplitude of said second audio signal; and
 - scaling said first spectral band signal by a second scaling factor to create a second signal portion.
2. A method for processing audio signals in accordance with claim 1, wherein said second scaling factor is proportional to said amplitude of said first audio signal.
3. A method for processing audio signals in accordance with claim 1, wherein said first and second audio signals are associated with directional channels in a multichannel audio system.
4. A method for processing audio signals in accordance with claim 3, further comprising,
 - filtering said first signal portion by a first filter to produce a filtered first signal portion, and
 - filtering said second signal portion by a second filter to produce a filtered second signal portion.
5. A method for processing audio signals in accordance with claim 4, wherein

$$\frac{SF1}{SF2} = \frac{ampl2}{ampl1},$$
 wherein *SF1* is said first scaling factor, *SF2* is said second scaling factor, *ampl1* is said amplitude of said first audio signal and *ampl2* is said amplitude of said second audio signal.
6. A method for processing audio signals in accordance with claim 5, wherein said first filter and said second filter include a filter portion having a frequency response and time delay effect similar to that of the human head.

- 1 7. A method for processing audio signals in accordance with claim 5, further comprising
2 combining said filtered first signal portion with said second audio signal.
- 1 8. A method for processing audio signals in accordance with claim 5, further comprising
2 combining said filtered second signal portion with said second spectral band signal.
- 1 9. A method for processing audio signals in accordance with claim 5, further comprising
2 combining said filtered first signal portion, said filtered second signal portion and said second
3 spectral band signal.
- 1 10. A method for processing audio signals in accordance with claim 4, further comprising the
2 step of combining said filtered first signal portion with said second audio signal.
- 1 11. A method for processing audio signals in accordance with claim 4, further comprising
2 combining said filtered second signal portion with said second spectral band signal.
- 1 12. A method for processing audio signals in accordance with claim 4, further comprising the
2 step of combining said filtered first signal portion, said filtered second signal portion and said
3 second spectral band signal.
- 1 13. A method for processing audio signals in accordance with claim 1, wherein
2 $\frac{SF1}{SF2} = \frac{ampl2}{ampl1}$, wherein *SF1* is said first scaling factor, *SF2* is said second scaling factor, *ampl1*
3 is said amplitude of said first audio signal and *ampl2* is said amplitude of said second audio
4 signal.
- 1 14. A method for processing audio signals in accordance with claim 1, further comprising,
2 filtering said first signal portion by a first filter to produce a filtered first signal portion,
3 and
4 filtering said second signal portion by a second filter to produce a filtered second signal
5 portion.
- 1 15. A method for processing audio signals in accordance with claim 14, wherein said first
2 filter and said second filter include a filter portion having a frequency response and time delay
3 effect similar to that of the human head.

1 16. A method for processing audio signals in accordance with claim 15, wherein one of said
 2 first filter or said second filter has filter portion having a frequency response and time delay
 3 effect similar to frequency response and time delay effect of the human head on a sound wave
 4 arriving from the front of said human head and the other of said first filter or second filter has
 5 filter portion having a frequency response and time delay effect similar to frequency response
 6 and time delay effect of the human head on a sound wave arriving from the rear of said human
 7 head.

1 17. A method for processing audio signals in accordance with claim 15, wherein said first
 2 filter and said second filter have a filter portion having frequency response and time delay effect
 3 similar to frequency response and time delay effect of the human head on a sound wave arriving
 4 from the front of said human head.

1 18. A method for processing audio signals in accordance with claim 15, wherein said first
 2 filter and said second filter have a filter portion having a frequency response and time delay
 3 effect similar to frequency response and time delay effect of the human head on a sound wave
 4 arriving from the rear of said human head.

1 19. A method for processing audio signals in accordance with claim 15, wherein said first
 2 filter and said second filter include a filter portion having a frequency response and time delay
 3 effect inverse to said filter having a frequency response and time delay effect similar to the
 4 human head.

1 20. A method for processing audio signals in accordance with claim 14, wherein one of said
 2 first filter or said second filters has a flat frequency response.

1 21. A method for processing audio signals in accordance with claim 20, wherein the other of
 2 said first filter or said second filters has a flat frequency response.

1 22. A method for processing audio signals in accordance with claim 14, further comprising,
 2 combining said filtered first signal portion with said second audio signal to produce a first
 3 combined signal.

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1 23. A method for processing audio signals in accordance with claim 22, with an audio system
 2 including a directional loudspeaker unit, said combining further including combining said second
 3 spectral band and said filtered second signal portion so that said first combined signal includes
 4 said filtered first signal portion, said filtered second signal portion, said second spectral band,
 5 and said second audio signal and further comprising,
 6 electroacoustically transducing, by said directional loudspeaker unit, said first combined
 7 signal.

1 24. A method for processing audio signals in accordance with claim 22, with an audio system
 2 further including a directional loudspeaker unit and a loudspeaker unit distinct from said
 3 directional loudspeaker unit and further comprising,
 4 combining said second spectral band and said filtered second signal portion to produce a
 5 second combined signal;
 6 electroacoustically transducing, by said loudspeaker unit, said second combined signal;
 7 and
 8 electroacoustically transducing, by said directional loudspeaker unit, said first combined
 9 signal.

1 25. A method for processing audio signals in accordance with claim 22 with an audio system
 2 including a directional loudspeaker unit and a loudspeaker unit distinct from said directional
 3 loudspeaker unit, said distinct loudspeaker unit substantially limited to radiating spectral
 4 components in said first spectral band, said combining further comprising,
 5 combining said second spectral band signal so that said first combined signal includes
 6 said filtered first signal portion, said second spectral band signal, and said second audio signal,
 7 said method further comprising,
 8 electroacoustically transducing, by said directional loudspeaker unit, said first combined
 9 signal; and
 10 electroacoustically transducing, by said loudspeaker unit, said filtered second signal
 11 portion.

1 26. A method for processing audio signals in accordance with claim 1, wherein said first
 2 scaling factor and said second scaling factor are variable with respect to time.

1 27. A method for processing audio signals in accordance with claim 1, wherein the sum of
2 said first scaling factor and said second scaling factor is one.

1 28. In an audio system having a first audio signal, a second audio signal and a directional
2 loudspeaker unit, a method for processing said audio signals comprising,
3 electroacoustically directionally transducing said first audio signal to produce a first
4 signal radiation pattern;
5 electroacoustically directionally transducing said second audio signal to produce a second
6 signal radiation pattern;
7 wherein said first signal radiation pattern and said second signal radiation pattern are
8 alternatively and user selectively similar or different.

9 29. A method for processing audio signals in accordance with claim 28 with an audio system
10 including a source of a third audio signal and a speaker unit separate from said directional
11 loudspeaker unit further comprising,
12 electroacoustically transducing said third audio signal by said speaker unit.

13 30. A method for processing audio signals in accordance with claim 29,
14 wherein said third audio signal is substantially limited to a frequency range having a
15 lower limit at a frequency that has a corresponding wavelength that approximates the dimensions
16 of a human head and
17 wherein said speaker unit is constructed and arranged to electroacoustically transduce
18 audio signals having frequencies in said frequency range.

1 31. A method for processing audio signals in accordance with claim 30, wherein said third
2 audio signal comprises a first spectral band of a scaled, filtered audio signal representing a
3 directional channel of a multichannel audio system.

1 32. A method for processing audio signals in accordance with claim 29, wherein said third
2 audio signal comprises a filtered scaled first spectral band of an input audio signal representing a
3 directional channel of a multichannel audio system and a second spectral band of said input
4 audio signal.

1

33. In an audio system having a first audio signal, a second audio signal, a third audio signal that is substantially limited to a frequency range having a lower limit at a frequency that has a corresponding wavelength that approximates the dimensions of a human head, a directional loudspeaker unit, and a loudspeaker unit, distinct from said directional loudspeaker unit, a method for processing said audio signals comprising,

electroacoustically directionally transducing by said directional loudspeaker unit said first audio signal to produced a first radiation pattern;

electroacoustically directionally transducing by said directional loudspeaker unit said second audio signal to produce a second radiation pattern; and

electroacoustically transducing by said distinct loudspeaker unit said third audio signal.

34. A method for processing audio signals in accordance with claim 33, wherein said electroacoustically directionally transducing comprises electroacoustically directionally transducing said first audio signal so that said first radiation pattern has a primary axis in a first direction and so that said second radiation pattern has a primary axis in a second direction different from said first direction.

35. A method for processing audio signals in accordance with claim 33, wherein said third audio signal comprises a first spectral band of a scaled, filtered audio signal representing a directional channel of a multichannel audio system.

36. In an audio system having a plurality of directional channels, a method for processing audio signals respectively corresponding to each of said plurality of channels, comprising,

dividing a first audio signal into a first audio signal first spectral band signal and a first audio signal second spectral band signal;

scaling said first audio signal first spectral band signal by a first scaling factor to create a first audio signal first spectral band first portion signal;

scaling said first audio signal first spectral band signal by a second scaling factor to create a first audio signal first spectral band second portion signal;

dividing a second audio signal into a second audio signal first spectral band signal and a second audio signal second spectral band signal;

scaling said second audio signal first spectral band signal by a third scaling factor to

12 create a second audio signal first spectral band first portion signal; and
 13 scaling said second audio signal first spectral band signal by a fourth scaling factor to
 14 create a second audio signal first spectral band second portion signal.

1 37. A method for processing audio signals, in accordance with claim 36, further comprising,
 2 filtering said first audio signal first spectral band first portion signal by a first filter to
 3 produce a filtered first audio signal first spectral band first portion signal,
 4 filtering said first audio signal first spectral band second portion signal by a second filter
 5 to produce a filtered first audio signal first spectral band second portion signal,
 6 filtering said second audio signal first spectral band first portion signal by a third filter to
 7 produce a filtered second audio signal first spectral band first portion signal, and
 8 filtering said second audio signal first spectral band first portion signal by a fourth filter
 9 to produce a filtered second audio signal first spectral band first portion signal.

10 38. A method for processing audio signals in accordance with claim 37 with an audio system
 11 having a directional loudspeaker unit, and a first loudspeaker unit and a second loudspeaker unit,
 12 both distinct from said directional loudspeaker unit and distinct from each other, said first and
 13 second distinct loudspeaker units substantially limited to radiating frequencies in said first
 14 spectral band, wherein said spectral band has a lower frequency limit that corresponds to a
 15 wavelength approximating the dimensions of the human head, said method further comprising,
 16 combining said first audio signal second spectral band signal, said second audio signal
 17 second spectral band, and a third audio signal to produce a first combined signal;
 electroacoustically transducing by said directional loudspeaker unit, said first combined
 signal;
 combining said filtered first audio signal first spectral band second portion with said
 filtered second audio signal first spectral band second signal first portion to produce a second
 combined signal;
 electroacoustically transducing by said first distinct loudspeaker unit said second
 combined signal; and
 electroacoustically transducing by said second distinct loudspeaker unit, said filtered
 second audio signal first spectral band second portion.

1 39. A method for processing audio signals in accordance with claim 38, further comprising,
 2 combining said filtered second audio signal first spectral band second portion signal with
 3 a filtered, spectral band-limited portion of a signal representing an adjacent channel to produce a
 4 third combined signal; and
 5 electroacoustically transducing by said second distinct loudspeaker unit, said third
 6 combined signal.

1 40. A method for processing audio signals in accordance with claim 37 with an audio system
 2 having a directional loudspeaker unit, a first loudspeaker unit distinct from said directional
 3 loudspeaker unit, and a second loudspeaker unit distinct from said directional loudspeaker unit
 4 and said first distinct loudspeaker unit, said method further comprising,
 5 combining a third of said plurality of audio signals and said filtered first audio signal first
 6 spectral band first portion to produce a first combined audio signal;
 7 electroacoustically transducing by said directional loudspeaker unit said first combined
 8 signal;
 9 combining said filtered second audio signal first spectral band first portion, said filtered
 10 first audio signal first spectral band second portion, and said first audio signal second spectral
 11 band to produce a second combined signal;
 12 electroacoustically transducing by said first distinct loudspeaker unit said second
 13 combined signal;
 14 combining said filtered second audio signal first spectral band second portion and said
 15 second audio signal second spectral band signal to produce a third combined signal; and
 16 electroacoustically transducing by said second distinct loudspeaker unit said third
 17 combined signal.

1 41. A method for processing audio signals in accordance with claim 40, further comprising,
 2 combining said filtered second audio signal first spectral band second portion signal with
 3 a filtered, spectral band limited portion of a signal representing an adjacent channel to produce a
 4 third combined signal; and
 5 electroacoustically transducing by said second distinct loudspeaker unit, said third
 6 combined signal.

1 42. A method for processing an audio signal, comprising,
 2 filtering said audio signal by a first filter, said first filter having a frequency response and
 3 time delay effect similar to the human head to produce a once-filtered audio signal;
 4 filtering said once-filtered audio signal by a second filter, said second filter having a
 5 frequency response and time delay effect inverse to the frequency and time delay effect of a
 6 human head on a sound wave.

1 43. A method for processing audio signals in accordance with claim 42, wherein said second
 2 filter has a time delay effect inverse to the frequency and time delay effect of a human head on a
 3 sound wave that originates at a preselected orientation relative to said human head.

1 44. A method for processing audio signals in accordance with claim 43, wherein said
 2 preselected orientation is an angle approximately thirty degrees relative to said human head.

1 45. A method for processing audio signals in accordance with claim 43, wherein said
 2 preselected orientation is a measured angle.

1 46. In an audio system having a plurality of directional channels first audio signal and a
 2 second audio signal, said first and second audio signals representing adjacent directional
 3 channels on the same lateral side of a listener in a normal listening position, a method for
 4 processing said audio signals, comprising,
 5 dividing said first audio signal into a first spectral band signal and a second spectral band
 6 signal;
 7 scaling said first spectral band signal by a first time varying calculated scaling factor to
 8 create a first signal portion; and
 9 scaling said first spectral band signal by a second time varying calculated scaling factor
 10 to create a second signal portion.

1 47. A method for processing audio signals in accordance with claim 46, further comprising,
 2 filtering said first signal portion by a first filter to produce a filtered first signal portion,
 3 and
 4 filtering said second signal portion by a second filter to produce a filtered second signal
 5 portion.

1 48. A method for processing audio signals in accordance with claim 47, further comprising,
2 combining said filtered first signal portion with said second audio signal to produce a first
3 combined signal.

1 49. A method for processing audio signals in accordance with claim 48 with an audio system
2 including a directional loudspeaker unit, said combining further including combining said second
3 spectral band signal and said filtered second signal portion so that said first combined signal
4 includes said filtered first signal portion, said filtered second signal portion, said second spectral
5 band signal, and said second audio signal, said method further comprising,
6 electroacoustically transducing, by said directional loudspeaker unit, said first combined
7 signal.

1 50. A method for processing audio signals in accordance with claim 48 with an audio system
2 further including a directional loudspeaker unit and a loudspeaker unit distinct from said
3 directional loudspeaker unit, said method further comprising,
4 combining said second spectral band signal and said filtered second signal portion to
5 produce a second combined signal;
6 electroacoustically transducing, by said loudspeaker unit, said second combined signal;
7 and
8 electroacoustically transducing, by said directional loudspeaker unit, said first combined
9 signal.

1 51. A method for processing audio signals in accordance with claim 48 with an audio system
2 further including a directional loudspeaker unit and a loudspeaker unit distinct from said
3 directional loudspeaker unit, said distinct loudspeaker unit substantially limited to radiating
4 spectral components in said first spectral band, said combining further comprising,
5 combining said second spectral band signal so that said first combined signal includes
6 said filtered first signal portion, said second spectral band signal, and said second audio signal,
7 said method further comprising,
8 electroacoustically transducing, by said directional loudspeaker unit, said first combined
9 signal; and
10 electroacoustically transducing, by said loudspeaker unit, said filtered second signal

11 portion.

1 52. In an audio system having an audio signal, a first electroacoustical transducer designed
 2 and constructed to transduce sound waves in a frequency range having a lower limit, and a
 3 second electroacoustical transducer designed and constructed to transduce sound waves in a
 4 frequency range having a second transducer lower limit that is lower than said first transducer
 5 lower limit, a method for processing audio signals, comprising,
 6 dividing said audio signal into a first spectral band signal and a second spectral band
 7 signal;
 8 scaling said first spectral band signal by a first scaling factor to create a first portion
 9 signal;
 10 scaling said first spectral band signal by a second scaling factor to create a second portion
 11 signal;
 12 transmitting said first portion signal to said first electroacoustical transducer for
 13 transduction; and
 14 transmitting said second portion signal to said second electroacoustical transducer for
 15 transduction

1 53. A method for processing audio signals in accordance with claim 52, wherein said audio
 2 signal corresponds to a directional channel in a multichannel audio system.

1 54. A method for processing audio signals in accordance with claim 1, further comprising
 2 time delaying said first spectral band signal relative to said second spectral band signal.